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Characteristics of Drug and Dietary Supplement Inquiries by College Athletes

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Background: In the United States, the National Center for Drug Free Sport manages the drug-testing programs for athletes of the National Collegiate Athletic Association (NCAA). Through its Resource Exchange Center (REC), Drug Free Sport supports athletic staff and athletes with information regarding drugs and dietary supplements.

Purpose: To characterize the types of drug-related and dietary supplement–related inquiries submitted to Drug Free Sport through the REC.

Study Design: Cross-sectional study.

Methods: All inquiries submitted to the REC for the period of September 1, 2005, through June 30, 2006, were reviewed. The data were categorized by the method of inquiry submission; the name of the substance in question; the sex, sport, and NCAA division of the athlete involved; the nature of the inquiry; and the response provided by the REC regarding the NCAA's status of the substance in question.

Results: Pseudoephedrine, acetaminophen/hydrocodone, and albuterol were the most commonly self-searched medications; stimulants accounted for the majority of banned medications. Dietary supplements accounted for 80% of all inquiries submitted to the REC via the Banned Drug Inquiry Form. Among all dietary supplements, creatine was the most commonly inquired. Banned substances accounted for 29% of all inquiries.

Conclusions: There were more than 10 000 inquiries regarding the status of medications, dietary supplements, and other substances for NCAA athletes during the 2005-2006 academic year. It is helpful for athletes to have resources that help them navigate banned-substance lists and so avoid the inadvertent use of banned substances.

Clinical Relevance: Educating athletes regarding the stimulant content of various dietary supplements and addressing the lack of clinical trials to support stated claims and safety appear critical.

Keywords: athletes; student athletes; drugs; dietary supplements; medication use; stimulants; National Collegiate Athletic Association; Drug Free Sport

Performance-enhancing substances have been used at all levels of athletic competition.[3] This use has affected Olympic athletes as well as athletes involved in professional and collegiate sports. Many factors may have contributed to this, including the rewards and fame for athletic success, the popularity and marketing of dietary supplements, and greater access to information and products sold over the Internet.[6]

Many sports organizations have created their own rules regarding the use of performance-enhancing substances, with each developing and maintaining their own banned-substance list. For example, the World Anti-Doping Agency is an independent international agency that manages the International Olympic Committee's doping control program, in addition to those of other national and international sports. The agency

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maintains its own banned-substance list, which also applies to individual countries that affiliate.[12] The United States Anti-Doping Agency is the national organization that regulates the doping control program of the United States Olympic Committee, and it follows the World Anti-Doping Agency's policies.[9] National-level professional sports leagues also have their own regulations and distinct antidoping policies and banned-substance lists. An athlete who competes under the auspices of multiple sports-governing organizations may be faced with rules that indicate that a substance is banned by one organization but not by another for the same sport. For example, a college athlete who competes under the National Collegiate Athletic Association (NCAA) and in the Olympics must abide by the doping control policies of both the NCAA and the World Anti-Doping Agency, which have similar but different banned-substance lists. The use of street drugs, prescription medications, and nonprescription medications leads to further confusion about the effects of these substances on an athlete's performance for a given sport. Given the widespread availability of these substances, it is not surprising that concerns have been raised about inadvertent use and the difficulty navigating multiple banned-substance lists. Adding to this confusion is the unwieldy promotion and hype of dietary supplements as a way to maintain health, improve strength and stamina, increase energy, and improve well-being. Therefore, it is not surprising that athletes and athletic staff would have questions regarding the appropriate use of these products and would need assistance regarding whether a substance is banned in general or banned for use in a given sport by a specific organization.

In the United States, the drug testing and education programs for collegiate athletes who participate in NCAA sports is managed by the National Center for Drug Free Sport. Through the Resource Exchange Center (REC), Drug Free Sport supports athletic staff and athletes with information regarding all medications, including street drugs and dietary supplements. The REC was developed with support from the NCAA in August 2000, and it provides a means for athletes and others involved in athletics to get timely, accurate information about medications and dietary supplements. The REC also provides information regarding whether a substance is banned or not banned by the NCAA. Today, the REC is used by other organizations, including the National Football League, Major League Baseball, the PGA Tour, and the Texas University Interscholastic League.

The REC is designed to accept inquiries from members of a subscribing organization. Inquiries submitted to the REC regarding a substance in question are researched to ensure response accuracy with respect to a substance's banned/not-banned status. Inquiries related to prescription and over-the counter medicines may be researched using the Drug Lookup feature of the REC Web site, which contains a populated database. For any medicines not listed in the Drug Lookup or for any dietary supplements, an individual inquiry may be submitted directly to Drug Free Sport staff online via the Banned Drug Inquiry Form (BDIF). Additionally, individual inquiries may be submitted by phone or e-mail. All inquiries are confidential and receive a response within 2 business days.

The REC therefore provides information about the types of drug-related and dietary supplement–related inquiries that are important to NCAA athletes and athletic staff. The purpose of this study is to characterize the types of inquiries and substances submitted to the REC by NCAA athletes or their athletic representatives via the Drug Lookup or the BDIF to help identify trends in medications and dietary supplements of interest in NCAA sports.

METHODS

The study was approved by the Committee on Human Research at the University of California, San Francisco. Data for the study were collected for the period of September 1, 2005, through June 30, 2006, approximately 1 academic year. Data collected from the Drug Lookup database contained the name of the drug queried, the date, and the status of the drug (ie, banned or not banned by the NCAA). If a substance was not included in the Drug Lookup database, the status field would appear blank and a statement would advise the user to submit an inquiry to the REC via the Web site by completing the BDIF.

Data collected from questions submitted to the REC via the BDIF included the following: method of submission, athletic involvement of inquirer, sport, NCAA division (I, II, III), sex, specific question to be answered, and the response from the REC regarding the status of the substance (or substances) in question. Any other identification of the inquirers was not collected. Some questions involved multiple substances; for this study, an inquiry was defined as a question pertaining to 1 specific product, ingredient, or topic. With regard to athletic involvement, each inquirer was asked to indicate if he or she was an athlete, athletic trainer, director of athletics, team coach, strength coach, parent, or other; however, some inquirers did not indicate this, given that it was not a required field. Sex was tabulated only for those inquirers who indicated that they were athletes, because it was not clear if other inquirers (eg, coaches, parents) indicated their own sex or the sex of the athlete and because some questions were general and not athlete specific. Replies from the REC regarding substances consisted of *banned*, *not banned*, *not specifically banned*, and *specifically banned for rifle*. It should be noted that in November 2005, the NCAA status for phenylephrine was changed from *banned* to *not banned*. Hence, the outcome of the inquiry for this drug depended on the date of inquiry, which this study accounted for.

Only those inquiries that were in the Drug Lookup database and those submitted to the REC using the BDIF (via the Web site, e-mail, or phone) were evaluated and characterized. Data for both the Drug Lookup inquiries and the REC inquiries submitted via the BDIF were downloaded to Microsoft Access 2000 (Microsoft Corporation, Redmond, Washington).

Inquiries about specific substances were classified as *prescription medications*, *nonprescription medications*, *dietary supplements*, *street drugs*, or *other*. Medications available as both prescription and nonprescription were considered nonprescription, unless further identification was provided (ie, strength or dose) to indicate otherwise. Prescription and nonprescription medications were further categorized by drug class. Dietary supplements were categorized on the basis of primary ingredients and known or purported effect. All products were categorized on the basis of the manufacturers' listed ingredients at the time of the study.

RESULTS

Drug Lookup

During the 10-month study period, there were 7203 inquiries to the Drug Lookup system; 5290 were for prescription and nonprescription medications contained in the database. As stated above, only those inquiries that were in the Drug Lookup database were evaluated (prescription and nonprescription medications), given that the inquirer was instructed to submit a question via the BDIF if the substance was not in the database. There were an average of 529 inquiries per month, the most occurring in November 2005 (n, 720) and the fewest in June 2006 (n, 164).

Table 1 contains the most commonly searched medications in the Drug Lookup. The majority of the 5290 inquiries were for prescription medications (69%). In total, the medication in question was banned for 1375 inquiries (26%); among these, 75% involved prescription medications and 25% involved nonprescription medications. Stimulants accounted for the majority of banned medications. As a class, analgesics constituted the majority of the products searched with the Drug Lookup.

Banned Drug Inquiry Form

The REC received 3904 submissions through the BDIF for a total of 5647 individual inquiries; that is, each submission often contained more than 1 question or product inquiry. Twenty-three inquiries were for products that could not be identified, likely because of misspelling the product or drug. The greatest number of banned-drug inquiries was received in September 2005 (n, 600) and the fewest in December 2005 (n, 164).

Inquirers had the option of indicating their athletic involvement and 87% of the submissions included this information. Athletic trainers submitted the majority of questions (54%), followed by athletes (36%), parents (4%), strength coaches (3%), other (2%), team coaches (< 1%), and directors of athletics (< 1%). With respect to those inquirers who indicated that they were athletes, 79% were men, 12% were women, and 9% did not specify. Indicating a sport was also optional; however, 64% of the inquirers indicated the sport involved. Among these, 80% of the submissions to the REC were associated with football, baseball, track and field, basketball, and soccer. The majority of the questions posed to the REC were associated with Division I schools (57%), followed by Division II (21%) and Division III (7%); 15% of inquirers did not specify a division.

Inquiries regarding dietary supplements accounted for 80% of all inquiries using the BDIF, whereas inquiries for prescription and nonprescription medications composed less than 15%. This is consistent with the fact that the Drug Lookup contains prescription and nonprescription medications only. There were 5 inquiries regarding street drugs: 4 for marijuana and 1 for gamma-hydroxybutyric acid. Approximately 6% of inquiries were miscellaneous questions, which consisted of nondrug topical products, shampoos, and general questions regarding drug testing and drug policies.

Creatine was the most common substance of inquiry among all based on the BDIF, either as a single ingredient or as one of multiple ingredients (see Table 2). The majority of dietary supplements that were classified as stimulants contained caffeine. Dietary supplements that claimed to release nitric oxide were common. The primary ingredient identified in nitric oxide dietary supplements was arginine, with glutamine also found as the primary ingredient in the minority of the nitric oxide products. Some of these products also contained creatine, whereas 30% contained caffeine (which was banned by the NCAA). Tribulus was identified as another popular ingredient, which constituted 38% of the inquiries regarding botanicals. Some of these supplements contained caffeine, which would put them in the banned category. There were 185 inquiries regarding products that contained colostrum, which contained insulin-growth factor and other peptide hormones.

Of the inquiries submitted through the BDIF, 550 (9.7%) concerned prescription medications (Table 3). Of those, 91 (16.5%) involved stimulants such as dextroamphetamine, amphetamine, methylphenidate, and modafinil—all of which were banned by the NCAA (although medical exceptions can be granted for approved medical conditions). Among the 226 inquiries regarding nonprescription medications, 17 (7.5%) were in the banned category. The majority of these products contained phenylephrine, which was removed from the banned-drug list during the study period, as mentioned previously (note that 7 of 54 inquiries are categorized as *banned* given that they were made before the change in status).

The NCAA's *banned* status was assessed in 5362 of the 5647 inquiries submitted through the BDIF, which excludes general questions and inquiries for products that could not be identified. More than half of all inquiries received a response indicating that the product was not specifically banned by the NCAA. Of the 1725 inquiries involving a banned product, 1591 (92%) were for dietary supplements, 107 (6%) for prescription medications, 17 (1%) for nonprescription medications, and 11 (< 1%) for street drugs and other substances that could not be classified as a drug or dietary supplement (eg, topical products containing caffeine). The majority of inquiries regarding street drugs were for marijuana. The majority of banned dietary supplements contained banned stimulants—predominantly,

Table 1. Most common medications searched in Drug Lookup: September 2005 to June 2006.

No.	Drug Name	Inquiries: n (%)	NCAA Status
1	Pseudoephedrine	435 (8)	NB
2	Acetaminophen/hydrocodone (Vicodin, Vicodin ES, Vicodin Tuss, Vicodin HP, Lortab)	330 (6)	NB
3	Albuterol (Proventil, Ventolin, albuterol)	319 (6)	
	Inhalation	214	NB
	Oral	105	B
4	Caffeine	225 (4)	B
5	Testosterone (Androgel, Androderm, testosterone)	181 (3)	B
6	Methylphenidate (Concerta, Ritalin, Ritalin LA, Ritalin SR, methylphenidate)	169 (3)	B
7	Adderall	123 (2)	B
8	Ephedrine tannate	112 (2)	B
9	Cocaine	104 (2)	B
10	Acetaminophen (acetaminophen, Tylenol, Tylenol PM)	99 (2)	NB
11	Prednisone	83 (2)	NB
12	Magnesium salts[a]	79 (1)	NB
13	Phrenilin with caffeine and codeine	70 (1)	B
14	Hydrocortisone[b]	63 (1)	NB
15	Acetaminophen with codeine (Tylenol with codeine, acetaminophen with codeine)	62 (1)	NB
15	Hydrocodone	62 (1)	NB
16	Dextromethorphan	58 (1)	NB
17	Codeine	57 (1)	NB
18	Phenylephrine tannate[c]	54 (1)	B/NB
18	Singulair	54 (1)	NB
19	Advair	49 (< 1)	NB
19	Fexofenadine (Allegra, fexofenadine)	49 (< 1)	NB
19	Ibuprofen (Motrin IB, ibuprofen)	49 (< 1)	NB
20	Claritin-D	45 (< 1)	NB
21	Zoloft	44 (< 1)	NB
22	Levalbuterol	43 (< 1)	NB
23	Claritin	42 (< 1)	NB
24	Methyltestosterone (Testred, methyltestosterone)	39 (< 1)	B
25	Nandrolone	37 (< 1)	B

Drug name is listed as indicated in the database; where multiple products and formulations were entered, the generic compound is listed first, with the specific product in parentheses. For products that are available with and without a prescription (e.g., different strengths or different formulations), the product was considered nonprescription unless the information entered by inquirer indicated the prescription product. NCAA, National Collegiate Athletic Association; B, banned; NB, not banned by the NCAA during the 2005-2006 academic year.

[a]Magnesium salts = Mg carbonate, Mg chloride, Mg gluconate, Mg hydroxide, Mg oxide.

[b]Hydrocortisone = hydrocortisone, hydrocortisone acetate, hydrocortisone butyrate, hydrocortisone sodium phosphate, hydrocortisone valerate.

[c]Phenylephrine inquiry results changed on November 7, 2005, from *banned* to *not banned* status; 7 of 54 inquiries are categorized as *banned*.

Table 2. Categories of dietary supplement inquiries posed to the Resource Exchange Center: September 2005 to June 2006.

Dietary Supplement Categories	Inquiries, n (%)[a]
Creatine	1282 (28.3)
Stimulant-containing products	1137 (25.1)
Nitric oxide products	861 (19.0)
Amino acids	581 (12.8)
Whole protein products	551 (12.1)
Botanical products	504 (11.1)
Anabolic precursors	271 (6.0)
Peptide hormone analogues	236 (5.2)
Vitamins and minerals	202 (4.5)

[a]Combination dietary supplements were classified under multiple categories; total exceeds 4536, 100%.

Table 3. Most common prescription medication classes submitted through the Banned Drug Inquiry Form: September 2005 to June 2006.

Prescription Medication Classification	Inquiries, n (%)[a]
Stimulants	91 (16.5)
Glucocorticoids	78 (14.2)
Analgesics	49 (8.9)
Antidepressants	47 (8.5)
Beta-2 agonists	41 (7.5)
Antihistamines	33 (6.0)
Antibiotics	18 (3.3)
Cough and cold	16 (2.9)
Hormone contraceptives	15 (2.7)
Anabolic agents	14 (2.5)
Muscle relaxants	12 (2.2)
Diuretics	10 (1.8)

[a]Combination medications were classified under multiple categories; total exceeds 550, 100%.

caffeine. Many of the dietary supplements involved a combination of ingredients; thus, if it contained a banned substance, then the entire product was banned by the NCAA. However, if the list of ingredients in a dietary supplement did not contain a banned substance, the inquirer was informed that the product was not specifically banned, but the following warning was included: "Dietary supplements are poorly regulated by the US FDA [Food and Drug Administration]. Therefore, we cannot guarantee the product's purity or safety. Impure supplements can cause a positive drug test. Athletes are advised that the use of dietary supplements is at the user's own risk."

DISCUSSION

Our study identified that football was the most common sport indicated by users of the REC's BDIF. Inquirers involved in other sporting events, such as baseball and track and field, were also common users of the REC. The months of November and February received the greatest number of inquiries.

Among all commonly searched medications in the Drug Lookup, pseudoephedrine, acetaminophen/hydrocodone (Vicodin), and albuterol were the most common. Pseudoephedrine, a sympathomimetic amine, is commonly used to treat nasal, sinus, and eustachian tube congestion. Given its popularity during the cough and cold season, it is not surprising that pseudoephedrine was the most commonly searched medication in the Drug Lookup database. Interestingly, pseudoephedrine was the drug involved in the controversy surrounding the 2000 Olympic Games, where all-around gymnastics champion Andrea Raducan forfeited her gold medal after testing positive.[1]

The third most commonly searched medication in the Drug Lookup database involved albuterol. This drug poses a unique challenge for athletes. Inhaled albuterol—which is commonly used for asthma, reactive airway disease, and other lung disorders—is not banned by the NCAA; however, other routes of albuterol administration, such as those involving the oral and intravenous formulations, are banned. As such, albuterol appeared as a common drug searched in the Drug Lookup database.

We also noted that there were more searches for prescription medicines than for over-the-counter medicines within the Drug Lookup database. Among the prescription medicines, stimulants accounted for the majority of the medications in the banned category. Indeed, the use of prescription medications among the US population has increased, as has the use of stimulant medications for medical conditions such as attention-deficit/hyperactivity disorder and attention-deficit disorder.[2] Similar increases in stimulant medication use have been identified among NCAA athletes since 1997.[8] College students with attention-deficit/hyperactivity disorder or attention-deficit disorder would therefore be likely candidates for using these medications given that concentration and attention are critical to doing well academically.

Athletic trainers and athletes were the most likely to submit questions to the REC by using the BDIF, possibly because they are more aware than parents and others that NCAA restrictions exist on performance-enhancing products. In addition, team

coaches and directors of athletics were less likely to be inquiring about a given substance for an athlete. Male athletes were more likely than female athletes to use the BDIF. This may reflect the predominance of inquiries associated with male sports, such as football, rather than an indicator of sex differences related to medication use, abuse, or interest in drug use in sports. This is an area for further analysis in future studies.

Among the BDIF inquiries, dietary supplements were the most common. In 1994, Congress passed the Dietary Supplement Health and Education Act.[11] It essentially allowed dietary supplements to be regulated as "food" rather than drugs. As such, dietary supplement manufacturers had no mandates to implement strict purity and potency standards, and they did not have to demonstrate evidence of safety or efficacy of their supplements in humans before marketing. In 2007, the Food and Drug Administration issued a final rule on the establishment of Good Manufacturing Practice standards for the dietary supplement industry.[10] These standards will be phased in over the next few years, although dietary supplement formulations manufactured before the new standards will likely be available on store shelves until supplies are exhausted. It is unclear how these standards will apply to Internet-only dietary supplement manufacturers and distributors. For athletes, the inadequate regulation and manufacturing of dietary supplements make these products problematic.[7] Despite better Food and Drug Administration oversight with regard to manufacturing, serious issues of supplement adulteration continue to occur, often resulting in the presence of unlabeled ingredients and in some cases contamination with prescription medications.[5] Given this inherent lack of purity and potency, using a dietary supplement may pose many unknown risks to an unsuspecting athlete. Another problem for athletes who use dietary supplements is that a dietary supplement may be reformulated with a banned substance without any obvious disclosure on the product label or advertising and without the athlete's noticing. Adding to this is the relative lack of access to evidence-based, high-quality information on dietary supplement use and safety in sports. For these reasons, the REC was cautious in responding to inquiries regarding dietary supplements and thus provided full disclosure of the unknown risks involved.

Among the many dietary supplement ingredients, creatine was the most common ingredient inquired through the BDIF. Creatine is purported to help increase muscle mass and improve strength in short-term, high-intensity anaerobic activities; this corresponds well to the most commonly indicated sport: football.[4] Caffeine was the second most commonly identified ingredient among dietary supplement inquiries. This is not surprising given that caffeine is added to combination dietary supplements in varying amounts to help improve concentration, energy, and well-being and is a common ingredient in weight loss products.

Athletes faced with questions regarding drug use are often confronted with many challenges. Even if an athlete knows that a prescription medication or an over-the-counter medication is not banned for a given sport today, the medication may pose problems later, if it is added to or removed from the banned-substance list. Keeping up with this information can be difficult. Added to this is the complexity of the administration route, where one formulation of a given drug is banned and another is not (eg, albuterol). Navigating multiple banned-substance lists for a given sporting event only adds to the confusion. For these reasons, resources and programs such as the REC can be helpful to athletes, sports organizations, and the medical community. Without access to credible and reliable information, athletes, athletic programs, and health care professionals would be faced with a daunting task of sorting through the literature and multiple banned-substance lists to help make educated decisions. Indeed, the result of having an athlete make a bad decision with regard to using a banned substance can have serious repercussions on the athlete, the athletic program, and the sporting event involved.

CONCLUSION

There were more than 10 000 inquiries regarding the status of medications and dietary supplements for NCAA athletics during the 2005-2006 academic year. Twenty-nine percent of the time inquirers were informed that the substance in question was banned by the NCAA. Educating athletes regarding the stimulant content of various dietary supplements and addressing the lack of clinical trials to support stated claims and safety appear critical. Programs and resources such as the REC can be helpful to athletes, athletic programs, and health care professionals to avoid the inadvertent use of banned performance-enhancing substances. Periodic studies such as this one will be conducted to monitor for trends and to identify areas to target educational programs.

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